

## Chemical-Mechanical Planarization Controller

5

### ABSTRACT

10 The invention provides a model-based control approach to chemical-mechanical planarization (CMP) control. The preferred embodiment comprises mathematical models of the CMP process. These models play a critical role in obtaining superior control performance. Model-based Control Design involves the construction of a dynamic mathematical model of the system to be controlled, e.g. a removal rate model of a CMP system. The model can then be evaluated  
15 via computer simulations, and validated using data from the system. The invention provides a method and apparatus that processes *in-situ* data from a suite of real-time sensors and produces real-time commands to multiple actuators, such as applied pressures, slurry-flow rate, and wafer/pad velocity. A key aspect of the invention is an integrated model-based pressure-temperature-  
20 velocity-slurry flow control system that includes many innovations in real-time mode identification, real-time gain estimation, and real-time control.